North South University

Department of Electrical & Computer Engineering

LAB REPORT- *08*

Course Code: *CSE231L*

Course Title: *Digital Logic Design*

Section: *09*

Lab Number: *09*

Experiment Name:

Synchronous Sequential Circuits

Experiment Date: *15-05-2024*

Date of Submission: *30-05-2024*

Submitted by Group Number: *02*

Group members:

Name	ID	Obtained Mark Simulation [5]	Obtained Mark Lab Report [15]
1. Munem Bulbul	2221314642		
2.			
3.			
4.			

Course Instructor: Omar Ibne Shahid (OISD)

Submitted To: Pritthika Dhar

Experiment Name: Synchronous Sequential Circuit.

Objective:

- Gain a practical understanding of state diagrams and state tables.
- Understand the concept of designing a sequential circuits using flip-flops.
- Design and implement a Synchronous Sequential Circuit given a state diagram.

Apparatus:

- 1x Ic 74107 J-K Flip-Flop
- 1x IC 7408 2-input AND Gates
- 1x IC 7404 Hex inverters (Not Gates)
- 1x IC 7432 2-input OR Gates.
- 1x IC 7474 Dual D Flip-Flops
- Trainer Board
- Wires.

Theory:

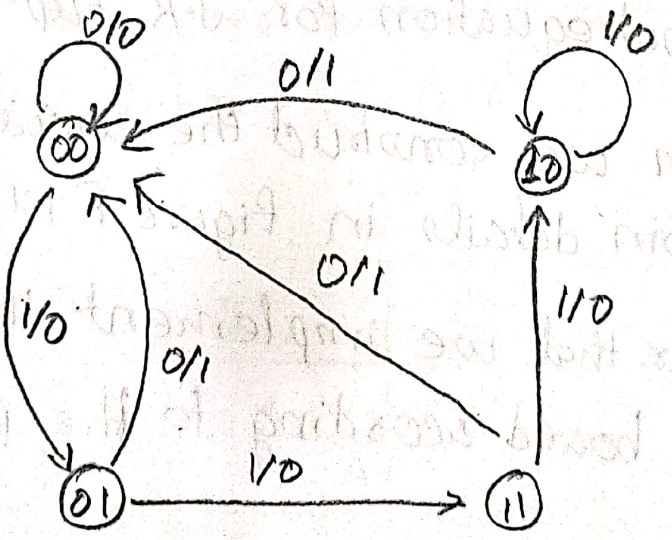
Synchronous sequential circuit composed of flip-flops and combinational logic where the outputs depends not only on the inputs but also on the circuits state. Flip-flops serve as memory elements to store info.

Synchronous sequential circuit consists clock signal which synchronizes the operations. On each clock pulse the inputs are sampled and outputs are updated based on the current state and combinational logic.

State diagram is used to describe the changes of the circuit. It shows the various states and the transition between them. The design process involves determining the required states, defining the state transition table and deriving logic equations.

The state table and state diagram for a sequential circuit.

Present State		Input	Next State		Output
A	B	x	A	B	y
0	0	0	0	0	0
0	0	1	0	1	0
0	1	0	0	0	1
0	1	1	1	1	0
1	0	0	0	0	1
1	0	1	1	0	0
1	1	0	0	0	1
1	1	1	1	0	0



Experiment: 1

01. Excitation table for JK flip-flop-

Q	Q_N	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

02. Using this excitation table, we complete the experimental data table.

03. After that we use the k-map to determine the input equation for J-K flip-flop.

04. Then we construct the circuit diagram with some pin details in figure F.1.1.

05. After that we implement the circuit in the trainer board according to the pin diagram

Experiment-2:

01. First we construct the excitation table for T flip-flop given below:-

Q	Q_N	T	x
0	0	0	
0	1	1	
1	0	1	
1	1	0	

Experiment-3:

01. Like the other two, let's construct the excitation table for D flip flop.

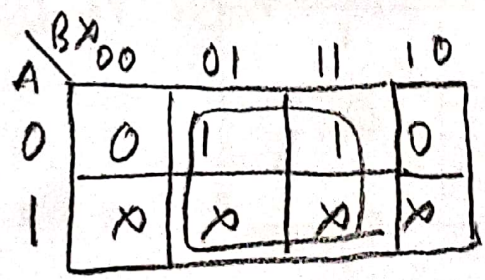
Q	Q_N	D
0	0	0
0	1	1
1	0	0
1	1	1

Experimental Data Table:

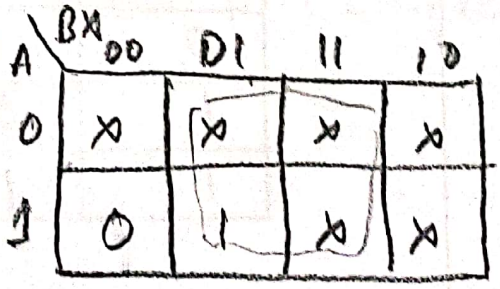
F1 Experimental Data: Constructing a sequential circuit using JK flip-flops.

Present state		Input	Next State		Output	Flipflop input functions			
A	B	X	A	B	Y	J_A	K_A	J_B	K_B
0	0	0	0	1	0	0	x	1	x
0	0	1	1	0	1	1	x	0	x
0	1	0	0	1	0	0	x	x	0
0	1	1	1	0	1	1	x	x	1
1	0	0	1	0	0	x	0	0	x
1	0	1	0	0	0	x	1	0	x
1	1	0	x	x	x	x	x	x	x
1	1	1	x	x	x	x	x	x	x

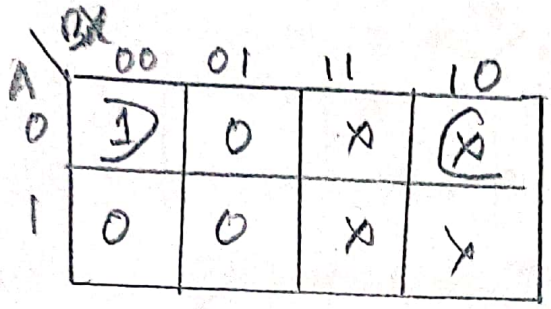
Table: F.11



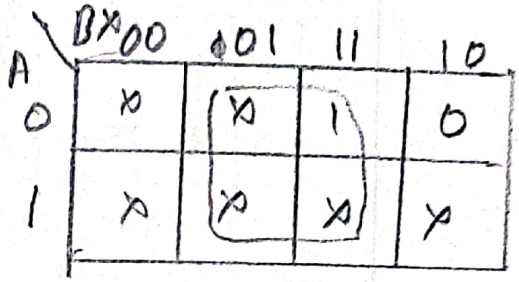
$J_A = x$



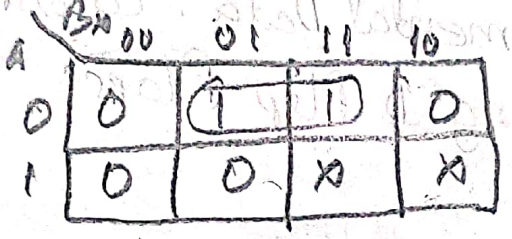
$K_A = x$



$J_B = \bar{A}\bar{X}$



$K_B = X$



$Y = \bar{A}X$

F.2 Experimental Data: Constructing a sequential circuit using T flip-flops

Present state		Input	Next state		output	Flip-Flop Input functions	
A	B	X	A	B	Y	T_A	T_B
0	0	0	0	1	0	0	1
0	0	1	1	0	1	1	0
0	1	0	0	1	0	0	0
0	1	1	1	0	1	1	1
1	0	0	1	0	0	0	0
1	0	1	0	0	0	1	0
1	1	0	X	X	α	X	α
1	1	1	X	X	α	X	α

F2:1 : State Table for T Flip-flop

A \ Bx	00	01	11	10
0	0	1	1	0
1	0	1	x	x

$T_A = x$

A \ Bx	00	01	11	10
0	1	0	1	0
1	0	0	x	x

$T_B = \bar{A}\bar{B}\bar{x} + Bx$

A \ Bx	00	01	11	10
0	0	1	1	0
1	0	0	x	x

$Y = \bar{A}x$

F.3 Experimental Data: Constructing a sequential circuit using D Flip-flops

Present state		Input	Next state		Output	Flip-Flop Input Function	
A	B	x	A	B	Y	D_A	D_B
0	0	0	0	1	0	0	1
0	0	1	1	0	1	1	0
0	1	0	0	1	0	0	1
0	1	1	1	0	1	1	0
1	0	0	1	0	0	1	0
1	0	1	0	0	0	0	0
1	1	0	x	x	x	x	x
1	1	1	x	x	x	x	x

Table: Fig. 1

A \ Bx	00	01	11	10
0	0	1	1	0
1	1	0	x	x

$D_A = \bar{A}x + A\bar{x}$

A \ Bx	00	01	11	10
0	1	0	0	1
1	0	0	x	x

$D_B = \bar{A}\bar{x}$

A \ Bx	00	01	11	10
0	0	1	1	0
1	0	0	x	x

$Y = \bar{A}x$

Results:

After completing the circuit we test the circuit with the data table and the state of the circuit was changing according to the given sequence. So, we can say that we have successfully implemented the circuit for a sequential state.

Questions and answers:

1. Simulation are attached on the back.

2. Yes.

The equation we find is as J-K Flip-flop.

We know that in J-K flip-flop if both inputs are same it works a lot like T Flip flop.

In the first and second experiment we used the same input of X and the data table of output Y are same for both.

So, we can say from our experiments that the output of Y is same for both JK and T flip flop.

3.

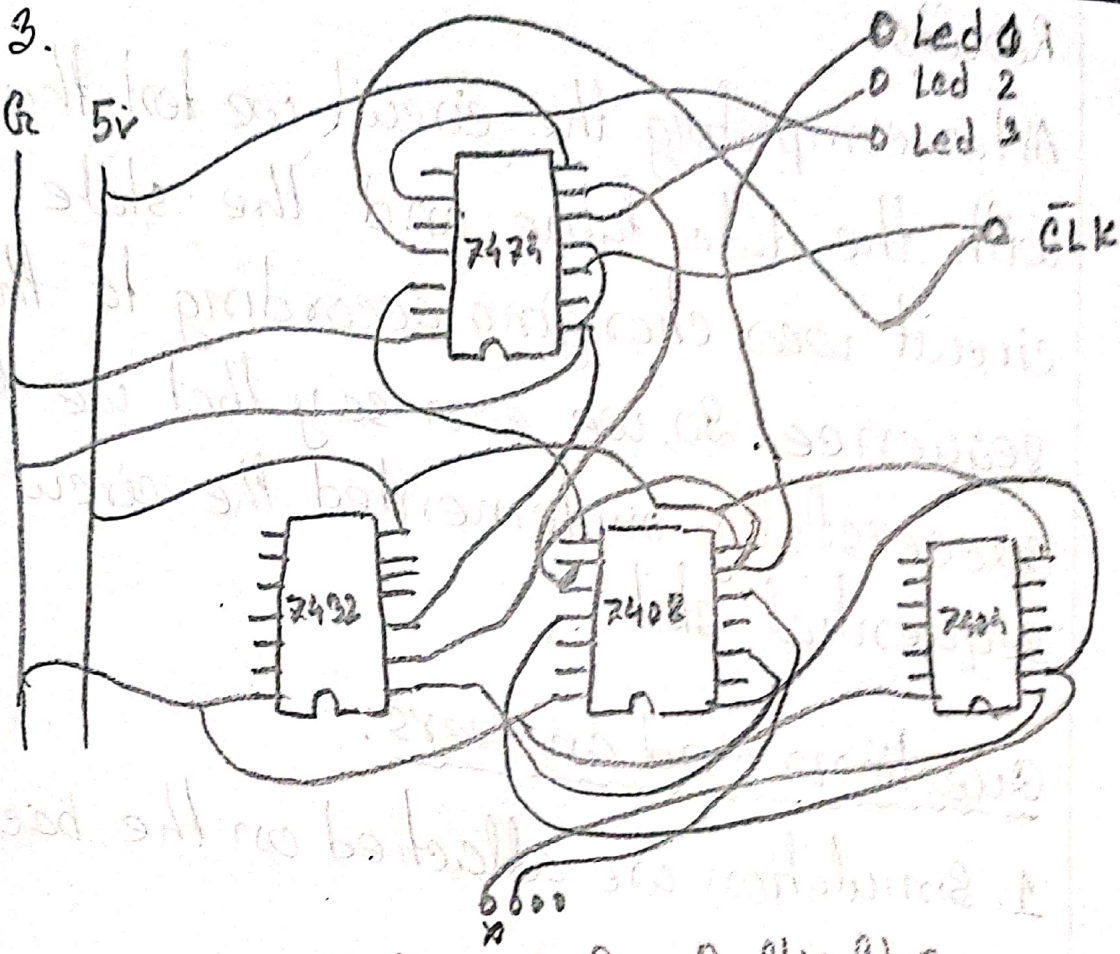


Fig: IC Diagram for D flip flop

Discussion: After constructing the sequential circuit we get to learn how the flip-flop works and all about state diagrams and tables. After completing these experiments we can say that, we can now easily build synchronous sequential circuits. Though it was one of the hardest and took us a lot of time to complete these experiments. It was hard and we also did & face some issues but we have completed the experiments.